



GPCS455

Good Practice  
Case Study

Installation of combined heat and  
power system by an energy services  
company at the Western General  
Hospital, Edinburgh

  
**ACTIONenergy**  
From the Carbon Trust



## The Business Case

### The partnership

The Western General Hospital cares for more than 150,000 patients every year striving to ensure that each patient receives the highest possible standard of care and treatment in the most appropriate environment. The Hospital provides specialist acute health care, locally, nationally and internationally in specialities such as Neurosciences and Oncology.

Scottish and Southern Energy Plc is one of the largest energy supply companies in the UK. It is involved in the generation, transmission, distribution and supply of electricity to industrial, commercial and domestic customers; energy trading; gas marketing; electrical and utility contracting and telecommunications. It is the largest generator from renewable resources in the UK, owning and operating around half of the total renewable generation capacity.

### Introduction

Scottish and Southern Energy owns, operates and maintains energy plant and equipment as part of an Energy Services Agreement to provide all of the heat and power required by the Western General Hospital. To fulfil these obligations, Scottish and Southern Energy has installed new boilers and a Combined Heat and Power (CHP) system. The CHP system generates electricity, steam and hot water efficiently, for use within the Hospital.

### Achievements

Scottish and Southern Energy has embarked on a £450m programme of investment, to develop a portfolio of renewable and low carbon generation. As part of this commitment to the environment Scottish and Southern Energy owns and operates a number of CHP plants throughout the UK. This helps Scottish and Southern Energy to achieve its environmental and Climate Change Levy (CCL) targets and to fulfil the expectations of customers and shareholders alike.

The business benefits to Scottish and Southern Energy are reductions in:

- carbon emissions with the associated CCL discount
- imported electricity
- the use of primary energy (gas and oil).

- CO<sub>2</sub> savings of up to 800 tonnes/annum
- Affordable boiler plant replacement and Combined Heat and Power system installation



The business benefits to the Hospital are:

- public funds freed up for core activities rather than investing in energy plant
- affordability
- risk transfer of project over-spend and/or over-run
- improved budgeting and cost control
- reduced energy cost by installation of energy efficient plant
- management resources have been released from maintenance, operation and environmental, health and safety matters.



## The Technical Case

### The existing energy sources

The Hospital previously imported electricity from the grid. There are significant losses associated with the generation and transmission of electricity. In the UK the average 'power station to plug' efficiency is approximately 35%, although this varies depending on the generation type.

At this site, steam was generated using gas/oil fired shell boilers. Typically boilers of this type are about 75% efficient.

### Combined Heat and Power (CHP) system

After evaluating the current and projected heat and power loads of the Hospital, Scottish and Southern Energy installed a gas fired, reciprocating engine CHP. To derive the best economic and environmental benefits from CHP it is necessary to optimise the size of the equipment to allow the highest possible utilisation. Hospitals generally have large continuous (base) heat and power demands and this is ideal for CHP. In this case the unit was sized to support a large proportion of the heat and power base loads.

The CHP system generates approximately  $1\text{MW}_e$  and this is stepped up to 11kV before being fed into the Hospital's high voltage ring main. The CHP system is sized to match the site's base load and can therefore be run at full output all year round. The system generates approximately 7.8GWh of electricity annually, producing a net carbon saving of approximately 800 tonnes/annum.



The exhaust gas is passed through a waste heat boiler to generate nearly 800 kg/h ( $500\text{kW}_{th}$ ) of steam at 7.5 bar, which is supplied directly into the Hospital steam main. Reciprocating engines offer high mechanical efficiencies and it is relatively easy to generate steam from larger engines, offering a very good degree of design flexibility.

Waste heat is recovered from the engine cooling and lubrication systems and is used to generate hot water at approximately  $90^\circ\text{C}$  and this is supplied to Hospital plant rooms, providing heating and domestic hot water. Approximately  $600\text{kW}_{th}$  of energy is extracted from the cooling system.

The on site generation of hot water, steam and electrical power allows a system efficiency of approximately 77% to be achieved. This is a significant improvement over traditional grid import and boiler operation and typically produces primary energy savings of more than 30%. The equipment has performed with a consistently high availability of 94%.



### Rules of thumb

- As CHP plants use both the heat and power from an engine they are much more efficient than generating electricity on its own or buying it from the grid. The overall efficiency is about twice that of stand alone electricity generation.
- CHP offers a significant primary energy,  $\text{CO}_2$  and cost savings.
- To get a return on investment the equipment should operate for a minimum of 5,000hrs per annum or more. Although maintenance is required a guaranteed availability of at least 90% will be necessary. Most manufacturers will agree to this.



## The Financial Case

This CHP project was delivered under an energy services contract with Scottish and Southern Energy. The term 'energy services agreement' describes an arrangement where the Hospital has contracted out the provision of its energy services to an Energy Services Company (ESCO) which recovers its capital outlay by way of revenue charges levied over the life of the contract. The agreement allows the Hospital to transfer the responsibility for ensuring cost-effective procurement, and security of supply and delivery. In this case the Hospital simply specified the energy requirements and the cost-effective and efficient provision of energy became Scottish and Southern Energy's responsibility. This route for development offers many distinct benefits for the Hospital, including:

- **Capital funding and affordability** Scottish and Southern Energy purchased and owns the CHP system and the boiler plant. The Hospital did not need to set aside capital funding for the development or upgrade of the boiler house.
- **Risk transfer** Scottish and Southern Energy operates and maintains the CHP system and other boiler plant to supply heat and power to the Hospital. Significant operational risk has therefore been transferred from the Hospital to Scottish and Southern Energy.
- **Improved budgeting and cost control** The energy services agreement has enabled revenue costs to be predicted and unforeseen maintenance costs to be avoided.
- **Improved energy efficiency** The use of CHP typically offers a primary energy reduction of over 30% and in this case is estimated to save approximately 800 tonnes/annum of CO<sub>2</sub>.
- **Freeing management resources** In this case, Scottish and Southern Energy takes responsibility for the operation and maintenance of the plant and Hospital staff have less involvement in the direct management of plant and services.
- **Environmental management** As plant operator, Scottish and Southern Energy can take on many of the duties and responsibilities for compliance with environmental targets and legislation.

## Action Energy assistance

### Expert advice

Action Energy provides **free** expert energy efficiency advice.

### Energy surveys

Your company may qualify for a **free** energy efficiency survey from one of Action Energy's qualified consultants.

### Action Energy loans

Action Energy can provide an interest free loan to SMEs in England, Wales and Northern Ireland of up to £50,000, repayable over up to 5 years for investment in energy efficiency measures. In Scotland the Scottish Executive offer a similar scheme called 'Loan Action Scotland'.

### Publications

A range of free publications is available including:  
*GPG043 Introduction to Large Scale Combined Heat and Power*  
*GPCS289 Getting signed up - Energy Services in the Public Sector*

For details of any of these services or free publications, contact the Environment & Energy Helpline on 0800 58 57 94 and select the Energy option, or visit the Action Energy website at [www.actionenergy.org.uk](http://www.actionenergy.org.uk). For Loan Action Scotland contact [www.energy-efficiency.org/howto/help/loan/](http://www.energy-efficiency.org/howto/help/loan/).

## Tax incentives

The whole capital value of energy efficient technologies which qualify under the Enhanced Capital Allowances scheme may be written down in the year of purchase. For further information go to [www.eca.gov.uk](http://www.eca.gov.uk).

## Sources of further information

For further information about CHP contact the Combined Heat and Power Association  
 35/37 Grosvenor Gardens  
 London SW1W 0BS  
 Tel: 020 7828 4077 Fax: 020 7828 0310  
 E-Mail: [info@chpa.co.uk](mailto:info@chpa.co.uk)  
[www.chpa.co.uk](http://www.chpa.co.uk)

---

Whilst we have taken reasonable steps to ensure that the information contained within this Guide is correct, we give no warranty and make no representation as to its accuracy and we accept no liability for any errors or omissions and nor does the Carbon Trust nor the Government.

Nothing in this Case Study is intended to be or should be interpreted as an endorsement of, or recommendation for any supplier, service or product.

The Carbon Trust is a Company limited by guarantee, registered in England and Wales, number 4190230.